ANALYSIS OF FIELD OBSERVATIONS ON THE TEST TUNNEL AT GARRISON DAM

BY

ALY ABDEL AZIZ SABRY

B.Sc., Fouad I University, 1941
M.S., Harvard University, 1949

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENGINEERING
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1952

URBANA, ILLINOIS

1952

ANALYSIS OF FIELD OBSERVATIONS ON THE TEST TUNNEL AT GARRISON DAM

BY

ALY ABDEL AZIZ SABRY

B.Sc., Fouad I University, 1941
M.S., Harvard University, 1949

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ENGINEERING
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1952

URBANA, ILLINOIS

1952

ACKNOWLEDGMENT

This thesis was prepared under the direction and guidance of Professor R. B. Peck, Research Professor of Soil Mechanics of the University of Illinois to whom the writer wishes to express his deep indebtedness and thanks.

The writer wishes to express his sincere appreciation to Professor C. P. Siess, Research Associate Professor of Civil Engineering of the University of Illinois whose comments and constructive criticisms have been especially helpful.

The data of the field measurements on the concrete section of the test tunnel were made available by the Corps of Engineers, U. S. Army, Garrison District. For their valuable assistance and generous cooperation, the writer is indeed grateful.

R. UNIV.
BIBLIOTHEEK
LEIDEN

ANALYSIS OF FIELD OBSERVATIONS ON THE TEST TUNNEL AT GARRISON DAM

Introduction

In 1947 the Corps of Engineers, U. S. Army began construction of Garrison Dam across the Missouri River, in west central North Dakota.

As part of the outlet works eight circular tunnels were constructed. The tunnels were mined through the Fort Union formation which can be described geologically as a compact shale with lignite layers, and can be classified from the engineering point of view as hard clay.

A full sized test tunnel was constructed as a part of one of the main tunnels. The bore of the test tunnel had a diameter of 36 feet and a length of 240 feet. The invert of the test tunnel was approximately 138 feet beneath the ground surface.

One section of the test tunnel, designated as section D, was lined with reinforced concrete three feet in thickness.

This thesis is concerned primarily with the evaluation of the inherent accuracy of strain measurements made on section D, and with the accuracy of the values of loads and stresses derived from these measurements.

It was determined that the strain gages, of the Whittemore type, performed satisfactorily under field conditions, and that computations of thrust, moment and shear based on the strain measurements have a relatively high degree of accuracy.

Vertical Load On The Tunnel

The vertical load on the tunnel increased from the time of rib erection in September 1948 until observations were discontinued on March 1951.

A noticeable increase in the rate of loading was observed

during the period in which part of the embankment of the dam was constructed above the tunnel. Mining the adjacent tunnels also caused an appreciable increase in the vertical load.

When observations were discontinued, the computed load on the tunnel exceeded 100 per cent of the weight of the soil located within the two vertical planes passing through the extremeties of the horizontal diameter of the tunnel.

Horizontal Load On The Tunnel

The horizontal load on the tunnel increased from the time of rib erection until observations were discontinued. Any increase or decrease in the vertical load was followed by a corresponding variation in the lateral pressure.

Ratio Of Horizontal To Vertical Load Acting On The Lining

The values of the ratio of horizontal to vertical load, based on the initial readings after concreting, vary from 0.67 to 0.27. The lowest ratio was recorded after one of the adjacent tunnels was driven. The highest ratio occurred after the placement of the embankment.

Moments Acting On The Lining

The general trend of the values of moment with time is approximately the same as that of vertical load. The moments show considerable increase with time. The average moment at the springlines was always higher than that at the crown and invert.

Diameter Changes

In the first two months after rib erection, the vertical diameter decreased 1.0 inch, and the horizontal diameter increased 0.6 inch. During the entire period of observation, the total decrease in the vertical diameter was 1.6 inches, and the total increase in the horizontal diameter was 1.2 inches.

A decrease in the vertical diameter and an increase in the horizontal diameter of about 0.12 inch were noticed on each occasion when an adjacent tunnel was mined.

ABBREVIATED BIBLIOGRAPHY

Seybold, J. S. "Constructors Roll Nearly One Million Yards a Week into Garrison Dam," Civil Engineering, October, 1949, P. 28.

Ballard, N. "Regional Geology of Dakota Basin," Bulletin American Assoc. of Petroleum Geologists, Vol. 26, no. 10.

Terzaghi, K. and Peck, R. B. "Soil Mechanics in Engineering Practice." John Wiley and Sons, New York, 1948.

VITA

Aly Abdel Aziz Sabry was born on December 25, 1919 in Alexandria, Egypt. After graduation from Abbassia High School in Alexandria in 1936, he entered Fouad First University of Cairo, Egypt, and received the degree of Bachelor of Science in Civil Engineering in June 1941. He then joined the Egyptian State Railways in July 1941 and worked as a designer and construction engineer until he was appointed to teach in the Faculty of Engineering of Farouk First University, Alexandria, Egypt, in October 1946.

In February 1948, he left for the United States of America to study and have practice in civil engineering.

Upon arrival in the United States in March 1948, he joined the Graduate School of Engineering of Harvard University. He received the degree of Master of Science in Civil Engineering from Harvard University in June 1949. He entered the Graduate College of the University of Illinois in September 1949, and held a fellowship from February to June 1952.

He is a Junior Member of the American Society of Civil Engineers and a member of the Egyptian Engineering Association. He is a member of Sigma Xi and Phi Kappa Epsilon Honorary Societies.